



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

SECOND PART EXAMINATION

EXAM REPORT MARCH / MAY 2017

This report is prepared to provide candidates, tutors and Supervisors of Training with information regarding the assessment of candidates' performance in the CICM Second Part Examination. Answers provided are not necessarily model answers but a guide as to what was expected and for use as an educational resource. Trainees should discuss the report with their tutors so that they may prepare appropriately for future examinations. Trainees should not rely solely on writing practice answers to previous exam questions for exam preparation, and first establish a strong knowledge base from learning at the bedside and studying relevant texts, journals and on-line sources.

The exam comprises a written section and an oral section. The written exam consists of two 2.5hr papers of 15 short answer questions each. Candidates are required to score at least 50% in the written section to be eligible to sit the oral section. The oral exam consists of eight interactive vivas and two separate clinical "hot cases".

The tables below provide an overall statistical analysis as well as information regarding performance in the individual sections. A comparison with data from the five previous exams is provided.

In all sections of the exam the candidate has to demonstrate performance consistent with that of a junior consultant, i.e. demonstrate he/she has the ability for safe, effective, independent practice as an Intensivist. Candidates who are not at this level are encouraged to defer their attempt at the exam.

Overall Performance	May 2017	October 2016	May 2016	October 2015	May 2015	October 2014
Presenting for written (Including OTS)	40	49	41	52	35	53
Carrying a pass from a previous attempt	9	14	14	12	21	3
OTS Exempt	0	0	0	0	0	0
Total number presenting (written + carry + OTS)	49	63	55	64	56	56
Invited to orals (>50% in written section)	24	34	27	35	27	40
Total number invited to oral section	33	48	41	47	48	43

Analysis of Performance in Individual Sections	May 2017	October 2016	May 2016	October 2015	May 2015	October 2014
Successful in the written section	24/40 60%	34/49 69%	27/41 66%	35/52 67%	27/35 77%	40/53 75%
Successful in the Hot Case section	15/33 45%	33/48 69%	18/41 44%	26/47 55%	32/48 67%	21/42 50%
Successful in both Hot Cases	11/33 33%	24/48 50%	7/41 17%	13/47 28%	17/48 35%	12/42 29%
Successful in the Viva section	24/33 73%	38/48 79%	18/41 44%	31/47 66%	40/48 83%	25/42 60%

Sectional Pass Rates	May 2017		October 2016		May 2016		October 2015		May 2015		October 2014	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	42%	90%	65%	93%	37%	80%	45%	80%	60%	80%	36%	88%
Hot Case 2	55%	95%	65%	90%	46%	90%	62%	85%	56%	88%	57%	85%
Viva 1	73%	85%	65%	88%	71%	92%	53%	93%	83%	90%	76%	95%
Viva 2	73%	90%	67%	85%	32%	70%	45%	88%	96%	95%	90%	92%
Viva 3	55%	71%	77%	95%	66%	90%	77%	85%	79%	100%	31%	78%
Viva 4	73%	93%	46%	90%	51%	80%	79%	78%	52%	88%	55%	90%
Viva 5	70%	77%	44%	95%	76%	85%	66%	85%	92%	90%	86%	100%
Procedure Viva	73%	90%	79%	100%	66%	85%	40%	90%	46%	81%	48%	80%
Radiology Viva	73%	94%	100%	92%	41%	89%	40%	95%	84%	90%	2%	61%
Communication Viva	52%	95%	60%	95%	10%	85%	47%	78%	65%	100%	24%	85%

Oral Section Pass Rates	May 2017	October 2016	May 2016	October 2015	May 2015	October 2014
Candidates who scored >50% in written section and passed the overall exam	17/24 71%	25/34 74%	15/27 56%	27/35 77%	19/27 70%	20/40 50%
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	21/33 64%	39/48 81%	18/41 44%	32/47 68%	37/48 77%	22/42 52%
Overall Pass Rate	21/49 43%	39/63 62%	18/55 33%	32/64 50%	37/56 66%	22/55 40%

EXAMINERS' COMMENTS

Written Paper

Twelve of the thirty questions had an overall pass rate of less than 50%. Topics covered by questions with a pass rate of less than 30% related to hypocaloric feeding in the critically ill, management of diabetic ketoacidosis, and the measurement and use of transpulmonary pressure.

As in previous exams, candidates who failed questions did so for one or more of the following reasons:

- Insufficient knowledge of the topic in question
- Insufficient detail and/or depth of the answer
- Poorly structured answer
- Inadequate reference to supportive evidence where relevant
- Failure to answer the question as asked
- Omission of all or part of the question

Candidates that failed questions most often gave insufficiently detailed answers that were not at the level expected of a junior consultant. Candidates often gave generic "proforma" answers that did not deal with the specific issues in the question.

Candidates are advised to read the questions carefully and thoroughly and ensure they answer the question as asked and address all parts of each question. **Candidates are reminded to make sure their writing is legible and to avoid using non-standard abbreviations.** Candidates are also reminded that professional conduct is assessed throughout the exam process and that inappropriate comments written on the answer paper are not acceptable.

Candidates who failed the written section passed an average of 11/30 questions compared with candidates scoring >50% and gaining an invitation to the oral section, passing an average of 21/30 questions.

SECOND PART WRITTEN EXAMINATION

- (A) Write your answers in the blue book provided
- (B) Start each answer on a **new page** and indicate the **question number**. It is not necessary to rewrite the question in your answer book
- (C) You should aim to answer each question in **ten** minutes
- (D) The questions are worth **equal** marks
- (E) Record your **candidate number** and each **question number** on the cover of each book and hand in all books

GLOSSARY OF TERMS

Critically evaluate:	Evaluate the evidence available to support the hypothesis
Outline:	Provide a summary of the important points
List:	Provide a list
Compare and contrast:	Provide a description of similarities and differences (E.g. Table form)
Management:	Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment
Discuss:	Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons

NOTE

Where laboratory values are provided, abnormal values are marked with an asterisk (*).

Please note that in this report all images from the SAQs have been removed.

Question 1

A 45-year-old male with a background of chronic liver disease is admitted to the Emergency Department (ED) with massive haematemesis secondary to gastric varices. He is managed with endoscopy and sclerotherapy.

- a) List four other causes for massive haematemesis. (10% marks)
- b) List the clinical indicators for risk of re-bleeding from the gastric varices. (20% marks)
- c) List the pharmacological agents that may reduce the risk of a re-bleed. (20% marks)

Following initial stabilisation and control of bleeding, he deteriorates with a variceal re-bleed.

- d) List the options for controlling the re-bleed **AND**, where appropriate, the relative advantages and disadvantages of these. (50% marks)

ANSWER TEMPLATE

a) Causes

- Gastric or duodenal ulcer with bleeding visible vessel
- Dieulafoy's lesion (large exposed arteriole within gastric wall)
- Tear at gastro-oesophageal junction (Mallory Weiss)
- Aorto-duodenal fistula
- Eroding cancer into vessel (short gastric artery, splenic artery)

b) Rebleed likely if:

- Advanced age
- Unable to band all varices
- Gastric > oesophageal varices
- Severe coagulopathy due to liver disease or massive transfusion
- Severity of portal hypertension or liver disease
- Size of varices – larger higher risk
- Presence of red signs (localised reddish spots on the mucosal surface of the varix)

c) Drugs to reduce risk of re-bleed

- Octreotide/somatostatin
- Vasopressin / terlipressin ± venodilator
- Tranexamic acid
- Oral Sucralfate (local anti-fibrinolytic effect)
- PPI infusion if concomitant ulcer bleeding
- Beta blockers e.g. propranolol if haemodynamics permit
- Short-term prophylactic antibiotics

d) Options for re-bleeding:

- Measure and fix coagulation, ongoing resuscitation
- Repeat endoscopy
 - Can be done in ICU although may be more appropriate in the operating theatre
 - Requires airway protection
 - Allows endoscopic variceal obturation or endoscopic variceal ligation
- TIPS to reduce portal pressure; risks of encephalopathy
 - Strategy of choice with initial treatment failure
 - May be contra-indicated in high MELD score
 - Complications of shunting blood away from liver and increased hepatic encephalopathy
- Balloon tamponade (Sengstaken, Minnesota)
 - Only useful in varices in the oesophagus or GO junction; not useful for gastric
 - Requires airway protection
 - Mucosal injury and necrosis
- Surgery
 - Ligation and resection of gastric vessels
 - Oesophageal venous ligation
 - Requires luminal incision; high risk of breakdown in context of liver disease
 - May not be available depending on local resources
- Balloon-occluded retrograde transverse obliteration (BRTO)
 - New technique and still undergoing evaluation
 - Increases portal hepatic blood flow and may be alternative for patients who may not tolerate TIPS
 - Obliterates spontaneous porto-systemic shunts and may aggravate portal hypertension

- Activated factor 7
 - Questionable efficacy
 - Highly pro-coagulant
 - May have a role in buying time to allow retrieval to a more specialised centre

Maximum Score	7.0
Percentage Passed	50.0%

Question 2

(Image removed from report.)

Please note: The following ECG has been recorded at 25 mm/sec and gain setting of 10 mm/mV.

A 73-year-old female collapsed in the Outpatient Radiology Department where she had been waiting to have a CT coronary angiogram. She had been given 160 mg verapamil to slow her heart rate for the scan. Her usual medications included sotalol 80 mg twice a day.

On arrival of the Rapid Response Team she was drowsy, cold and peripherally shut down with systolic blood pressure 60 mmHg. Her arterial blood gas results at the scene are below, and her ECG is shown on page 3 (Figure 1).

Parameter	Patient Value	Adult Normal Range
FiO ₂	0.5	
pH	7.05*	7.35 – 7.45
pCO ₂	40.4 mmHg (5.3 kPa)	35.0 – 45.0 (4.6 – 6.0)
pO ₂	221 mmHg (29.1 kPa)	
SpO ₂	98%	
Bicarbonate	10.5 mmol/L*	22.0 – 26.0
Base Excess	-17.9 mmol/L*	-2.0 – +2.0
Lactate	8.0 mmol/L*	0.5 – 1.6
Sodium	132 mmol/L*	135 – 145
Potassium	5.4 mmol/L*	3.5 – 5.0
Chloride	105 mmol/L	95 – 105
Glucose	5.3 mmol/L	3.5 – 6.0

- a) Give the likely underlying cause for the patient's collapse. (10% marks)
- b) Interpret the investigations. (20% marks)
- c) Outline specific therapies for the management of this patient, indicating the doses and mechanisms of action for any pharmacotherapy you have listed. (70% marks)

ANSWER TEMPLATE

- a) Cardio-toxicity from a combination of a beta-blocker and calcium channel blocker resulting in cardiogenic shock.

Candidates may include a differential diagnosis – MI and cardiogenic shock not unreasonable.

- b) Metabolic (lactic) acidosis with inadequate respiratory compensation
 - A-aDO₂ approx 85 mmHg – raised for 73-year-old

- Junctional bradycardia (but much slower than expected). Ventricular escape rhythm acceptable. Peri arrest.

c) Specific therapies

Statement on resuscitation (Rapid ABC; iv access; O2, start CPR if indicated, monitor, rapid echo).

Multiple agents often required with stepwise approach.

- **Atropine** 1mg stat (can be repeated x 3; often ineffective; muscarinic receptor antagonist increases SA node discharge, conduction through the AV node and opposes action of Vagus nerve)
- **Adrenaline or Noradrenaline** infusion starting at 10-20 µg/min and titrate to a MAP > 65 mmHg (+ve inotropy, chronotropy, vasoconstriction)
- **Calcium** – Chloride or Gluconate can be given (more calcium in CaCl) – 10mls of 10% solution (can be repeated x3 +/- infusion; competitively increases calcium entry into the myocardium via non-blocked channels)
- **Glucagon** 5mg stat (can be repeated x3; increases intracellular cAMP and has been shown to increase heart rate in BOTH beta-blocker and CCB toxicity).
- 100mls 8.4% **NaHCO3** stat (she is already very acidotic)
- **Hyperinsulinaemia-Euglycaemia** – short acting insulin 1 unit/kg with 50mls 50% Dextrose bolus, then 0.5 units insulin /kg/hr with 10% dextrose infusion and q1hrly BGLs and K+ (high dose insulin = +ve inotrope but mechanism not clearly understood)
- **Lipid Emulsion** – 1ml/kg 20% lipid emulsion bolus (can be repeated x 3 then start infusion 0.5mls/kg/min; acts as a “lipid sink” surrounding lipophilic drugs rendering them ineffective & maybe fatty energy source for myocardium)

Other Therapies

- Trans-cutaneous pacing
- Trans-venous temporary pacing.
- VA-ECMO

Additional Examiners' Comments:

Many candidates failed to interpret the ECG, or to discuss the mechanism of therapies. Basic knowledge gaps in many answers.

Maximum Score	6.9
Percentage Passed	40.0%

Question 3

Critically evaluate the use of High Flow Nasal Prongs (HFNP) in adult ICUs.

ANSWER TEMPLATE

Definition & Equipment:

Variable FiO₂ high flow (20L/min or more), humidified and heated to 37°C applied by specific nasal cannulae. The cannulae are soft, and have a wide aperture; such that the gas velocity is less for a given flow than conventional cannulae; this aids in patient tolerance.

Use:

- Varied and has become common and widespread
- Hypoxaemic respiratory failure of any cause
- Post extubation
- Maintenance of oxygenation during procedures (intubation, bronchoscopy, TOE, GI endoscopy)
- Paediatrics
- May be used in hypercapnic respiratory failure as reduces dead space; less evidence in this group
- Oxygen therapy in treatment limitation / palliation / not for intubation settings

Rationale & Physiologic Advantages:

- High flow “washes” dead space
- Mechanical splinting of nasopharynx prevents supraglottic collapse
- Small amount of CPAP with effects on work of breathing
- Well tolerated generally, and therefore
- Consistent oxygenation
- Known and titratable FiO₂; potentially reduces periods of hypoxia and hyperoxia
- Humidification may be of benefit in reducing epithelial injury in patients with hyperpnoea

Disadvantages:

- PEEP is variable and difficult to measure
- PEEP drops to ~2 cmH₂O when mouth open
- More costly and more complex to set up than standard nasal cannulae

Adverse effects:

- Local trauma, discomfort and pressure areas
- Epistaxis
- Gastric distension
- Secretions block cannulae
- May delay intubation and lead to worse outcomes
- Excessive PEEP may cause PTX in neonates

Evidence:

- NEJM Study; Frat et al (France) 2015 (DOI: 10.1056/NEJMoa1503326)
 - Multicenter
 - NIV vs FMO₂ vs HFNP
 - No change in intubation rates
 - Mortality advantage over NIV and face mask O₂
 - Favourable editorial at the time
- Other studies:
 - Some have shown decreased re-intubation rates
 - THRIVE as pre-oxygenation may be better than RSI
 - Delays intubation (Kang, 2015)
 - THRIVE (Anaesthesia, Pateal, 2015) Mean apnoea time in difficult intubations 14min, but PREOXYFLOW (Vour'ch, 2015) lowest SpO₂ no better than high flow face mask
 - Post extubation HFNP x24h equivalent to NIV (Hernandez, JAMA 2016)

Summary statement and personal practice opinion.

Additional Examiners Comments:

Many candidates failed to list the indications for this therapy and the knowledge of the evidence and patient groups studied was poor.

Maximum Score	7.8
Percentage Passed	72.5%

Question 4

Discuss the potential mechanical strategies for supporting myocardial function in a 45-year-old male presenting with cardiogenic shock post-revascularisation for an acute anterior myocardial infarction.

In your answer include the physiological rationale for each strategy.

ANSWER TEMPLATE

Positive End Expiratory Pressure

This can either be delivered invasively or non-invasively. By increasing the positive pressure within the thoracic cavity, venous return to the heart is reduced thereby reducing cardiac preload to facilitate movement back to the optimal point on the Starling Curve. Also reduces afterload by reducing pressure gradient across the myocardial (left ventricular) wall. Also reduces work of breathing (reduces cardiac work) and improves PaO₂ (O₂ delivery to coronary blood flow).

Intra-Aortic Balloon Pump

The inflation of the intra-aortic balloon pump at the time of diastole increases coronary perfusion to increase cardiac contractility and reduces the after load at the commencement of systole as the balloon deflates.

Pacing

Emergency transcutaneous, temporary transvenous and permanent multi-chamber pacing. Improves cardiac output by optimising the heart rate and/or synchronising A-V conduction optimising “atrial kick”. Increasing the heart rate to normal in profound bradycardia as $CO = SV \times HR$. Overdrive pacing in tachyarrhythmias to re-establish normal conduction and then slow the heart improves cardiac output by increased ventricular filling and improved coronary artery perfusion in diastole.

Ventricular Assist Devices

This provides either a continuous or pulsatile pumping of blood from the left ventricle directly into the aorta (LVAD) or from right atrium or right ventricle directly to pulmonary artery (RVAD) or functions as both (BIVAD).

Decreases workload of the heart whilst maintaining adequate flow and blood pressure.

Indicated if potentially reversible myocardial stunning or as a bridge to transplantation or for support during high-risk revascularisation procedures. In this patient as a bridge to transplantation may allow management as outpatient. Requires cardiac surgical expertise for insertion and so not available in all centres.

Veno-Arterial Extra Corporeal Membrane Oxygenation

Venous blood is extracted, oxygenated externally and then pumped and returned to the arterial system providing both oxygenation and circulation. Decreases workload of heart and lungs whilst maintaining flow, blood pressure and oxygenation.

Requires expertise for insertion and maintenance and not available in all ICUs.

Maximum Score	7.8
Percentage Passed	82.5%

Question 5

A 53-year-old male is admitted to the ICU post 12-hour head and neck surgery. He has no other significant past medical history and normal baseline renal function.

Eight hours post ICU admission he is increasingly oliguric with dark-coloured urine. His laboratory results are as follows:

Parameter	Patient Value	Adult Normal Range
Sodium	130 mmol/L*	134 – 146
Potassium	6.5 mmol/L*	3.4 – 5.0
Creatinine	320 µmol/L*	45 – 90
Urea	15.0 mmol/L*	3.0 – 8.0
Ionised calcium	0.85 mmol/L*	1.10 – 1.35
Phosphate	2.6 mmol/L*	0.8 – 1.5
Albumin	28 g/L*	35 – 50
Total bilirubin	20 µmol/L	< 26
Aspartate transferase	510 IU/L*	< 35
Alanine transferase	100 IU/L*	< 35
Alkaline phosphatase	110 IU/L*	30 – 110
Haemoglobin	150 g/L	120 – 160
White Cell Count	20.0 x 10 ⁹ /L*	4.3 – 10.8
Platelet count	400 x 10 ⁹ /L*	150 – 350

- Give the most likely cause for the above results **AND** the rationale for your answer. (30% marks)
- List four other useful investigations. (10% marks)
- Briefly outline your management of this condition. (40% marks)
- List four drugs that can cause this condition. (20% marks)

ANSWER TEMPLATE

- The results indicate rhabdomyolysis.
The history is suggestive of muscle ischaemia from the prolonged duration of surgery and likely immobilization. The classic biochemical picture of hyperkalaemia, hyperphosphatemia, hypocalcaemia, high aspartate aminotransferase (AST), AKI with reduced Urea:Creatinine make rhabdomyolysis an important diagnosis to exclude. Other differentials causing an acute kidney injury are unlikely.
- CK levels
 - ECG
 - Urine for myoglobin
 - Serum lactate dehydrogenase (LDH)
- Treat the cause; muscle debridement / fasciotomy if indicated
 - Ensure adequate hydration – you need generous amounts of fluid aiming for urine output

1ml/kg/h

- Consider urinary alkalization with bicarbonate to keep pH > 6.5 (although there is limited evidence above fluid alone)
- Treat hyperkalaemia along conventional lines
- CRRT if remains oliguric, increasing U and Cr

d)

- Statins
- SSRIs
- Drugs of abuse: cocaine, amphetamines, heroin, LSD, 'Ecstasy'

Maximum Score	8.3
Percentage Passed	72.5%

Question 6

A 64-year-old female patient has been ventilated in your ICU for 36 hours with septic shock and is receiving significant doses of noradrenaline and vasopressin. On the morning review you note her troponin level is elevated to over 10 times the normal range for your institution.

- a) How do you interpret the raised troponin level in this setting (40% marks)
- b) Outline your assessment and management plan specific to the raised troponin level (60% marks)

ANSWER TEMPLATE

- a) Interpretation of raised troponin- should not be used in isolation in this patient. The measured value of troponin is high and should not be ignored or dismissed. If unexpected, repeat the test. Symptoms of chest pain are not easy to elicit in the ventilated patient. Troponin leak in this setting may be due to myocarditis associated with sepsis, acute cardiomyopathy. Takotsubo disease given high dose vasopressor or a STEMI or NSTEMI or right ventricular disease. Elevated troponin in renal failure should also be considered if relevant. Elevated troponins are associated with poor outcomes in septic patients.
- b) Management plan- Comprehensive clinical assessment especially cardiovascular and haemodynamic assessment. Look for recent, rapid increase in vasopressor requirement, signs of cardiogenic shock. Review ECG for any evidence of STEMI or other new changes, Review CXR for new pulmonary oedema/heart failure. Echo- transthoracic or if available TOE is mandatory to look for any regional wall motion abnormalities that may be new. Evidence of global changes on echocardiography may indicate acute cardiomyopathy e.g. Myocarditis. Look for classic changes of Takotsubo's.

Further management will be determined by ECG and echo findings. Cardiology review, anticoagulation, careful consideration of thrombolysis or angioplasty if STEMI or regional changes on echo with consideration given to haemodynamic instability and challenges of transfer and management in cardiac catheter lab. Role of IABP in global hypokinesia related to acute cardiomyopathies.

Troponin increases in septic patients is thought to be associated with poor prognosis

Additional Examiners' Comments:

Candidates were not expected to reproduce the template, but to demonstrate a reasonable and structured approach to the issue.

Maximum Score	8.3
Percentage Passed	75.0%

Question 7

You are asked to urgently review a 48-year-old male who has been in ICU for three weeks following an episode of severe community-acquired pneumonia. He had a percutaneous tracheostomy sited one week ago and has now developed sudden bleeding out of his airway.

- a) List the possible causes for the bleeding. (30% marks)
- b) Outline your assessment and management of the situation. (70% marks)

ANSWER TEMPLATE

a) Possible causes

Medical

- Coagulopathy
 - Coagulation factor deficiency
 - (related to vitamin k def from antibiotics)
 - Excess anticoagulation medication
 - Thrombocytopenia
 - DIC from sepsis
 - Antiplatelet medications
- Complication of pneumonia
 - Abscess
 - Neoplasm causing pneumonia now bleeding
- Less likely
 - Non-airway – blood from mouth, nose (post NGT) or GI tract tracking past trache tube cuff
 - Cardiac – mitral stenosis, tricuspid endocarditis
 - Vascular – PE, pulmonary infarction, AVM
 - Systemic disease – Wegeners, Goodpastures, SLE

Surgical

- Tracheostomy site
 - Granulation tissue in track
 - Innominate artery fistula (not common but very bad)
 - Thyroid artery
 - Anterior jugular vein
- Trachea
 - Suction trauma

b) This is an emergency situation with risks of hypoxia, aspiration and hypovolaemia

Assessment and management

- Resuscitation
- History and examination to determine cause/contributing factors
- Supportive therapy
- Specific therapy

Initial management will depend on the volume and extent of bleeding. Even small amounts of bleeding from a tracheostomy are potentially life threatening as may clot and occlude airway.

Resuscitation

- 100% FiO₂
- Ensure airway clear
 - Pass suction catheter, suction blood only if necessary, repeated suctioning may exacerbate problem, may need to change inner cannula
 - If ventilation not possible via trachea, may need to reintubate orally (pass ETT distal to stoma) to allow ventilation and protect distal airway from soiling
- Ventilate with safe volume and pressure limits as able
- Nurse in lateral decubitus position with bleeding lung (if known) down
- Ensure adequate venous access, fluid resuscitation as needed, check coagulation status and platelet count, organise factor replacement as required.
- In the case of exsanguination/brisk bleeding will need to enlist assistance of ENT +/- cardiothoracic surgery +/- interventional radiology

History and examination

Once initial situation settled, obtain history and perform examination of tracheostomy site to determine likely contributing factors from the above list of potential causes e.g. difficulty performing tracheostomy, progress of pneumonia, medications, recent blood results, co-morbidities, suction technique.

Investigations

- Fibre-optic bronchoscopy to identify bleeding site
- Coagulation profile and ROTEM/TEG
- CXR
- CT/CTPA if adequately stable

Specific treatment

Will depend on the cause identified:

- Granulation tissue – as per surgical site bleeding with lower threshold for surgical exploration
- Tracheo-inominate artery fistula (TIF) – bronchoscopy and angiography may fail to identify the source. TIF should be suspected in any patient suffering major haemoptysis post tracheostomy insertion. Management consists of over inflation of the tracheostomy cuff. If this fails to control bleeding then distal orotracheal intubation (tip at or beyond carina) followed by digital insertion through the pretracheal space and compression of innominate artery against the manubrium. This should be followed by urgent surgical exploration.
- Use of bronchial blocker / double lumen tube
- Bronchial artery embolization
- Surgical lobectomy or pneumonectomy if embolization fails
- Correction of coagulopathy – consider TXA
- Antimicrobial agents for infection
- Immunosuppression for underlying vasculitis
- Treatment of less likely causes as indicated

Additional Examiners' Comments:

Candidates were not expected to provide the level of detail in the answer template. The management component required resuscitation and specific management for pulmonary haemorrhage and tracheostomy related haemorrhage including innominate-tracheal fistula. Several candidates failed to mention this pathology or its management.

Maximum Score	7.0
Percentage Passed	40.0%

Question 8

You are asked to admit a 46-year-old male who has just been intubated in the Emergency Department (ED) after collapsing from a brain stem stroke, two hours earlier. His Glasgow Coma Scale (GCS) prior to intubation was 6.

Outline your management strategy for him for the first 24 hours.

ANSWER TEMPLATE

Resuscitation, definitive and supportive treatment.

Activate the stroke team if available in this hospital as urgent intervention is needed for the best potential outcome – involves neurologist and interventional neuroradiologist.

Attention to ABC (confirm tube position, adequacy of ventilation, control hypertension and treat hypotension to ensure adequate CPP).

Investigations / Interventions

- Interventional cerebral angiography if facilities and resources available or transfer to specialist centre if within acceptable time window
Note: Acceptable time window varies between centres but may be up to 12hrs or longer if CT perfusion scan shows salvageable brain.
Although recent trials have shown benefit for acute thrombectomy in acute stroke, brain stem stroke was not well represented in the study population. However, it is so potentially devastating that thrombectomy is advocated
- Some centres may combine with IA fibrinolysis (recent papers including one from RMH showing some good outcomes with IA fibrinolysis up to 24-48 hours post stroke)
- Systemic thrombolysis if specialist neuroradiological intervention not available
- Heparin infusion
- Aspirin

Physiological monitoring and maintenance of normal parameters (BP, Na, BSL etc.).

Role of EVD if hydrocephalus is present.

Ongoing neurological assessment – at risk of progressing to locked in syndrome.

Supportive care of the intubated ventilated critically ill patient.

Discussion with family re therapy and outlook plus risk factors for poor outcome.

Investigation for underlying cause / risk factors and treatment as appropriate.

Maximum Score	6.8
Percentage Passed	37.5%

Question 9

9.1

A 51-year-old female presents with a decreased conscious state, Glasgow Coma Scale (GCS) 12, confusion and myoclonus. She is on treatment for a seizure disorder. Her CT brain scan shows no acute intracranial abnormality.

Her investigations are as follows:

Parameter	Patient Value	Adult Normal Range
Sodium	138 mmol/L	135 – 145
Potassium	4.1 mmol/L	3.5 – 5.2
Bicarbonate	18 mmol/L*	22 – 32
Urea	14.2 mmol/L*	3.0 – 8.0
Creatinine	210 µmol/L*	45 – 90
Bilirubin	54 µmol/L*	< 20
Alanine transferase	2710 U/L*	< 35
Aspartate transferase	1365 U/L*	< 35
Alkaline phosphatase	103 U/L	30 – 110
γ-Glutamyl transferase	67 U/L*	< 40
Albumin	37 g/L	35 – 50
Protein	61 g/L	60 – 80
Ammonia	156 µmol/L*	< 50

List three possible causes of the hyper-ammonaemia in this patient.

(40% marks)

ANSWER TEMPLATE

9.1

- Liver failure
- Anti-epileptic drugs – Sodium valproate and Carbamazepine
- Other drugs / toxins eg paracetamol, salicylates, mushrooms
- Urosepsis with urea-splitting organisms e.g. Klebsiella, Proteus
- Urea-cycle disorders (*Patients with high ammonia from drugs or urosepsis usually have undiagnosed mild disorders of urea-cycle metabolism*)

9.2

The following blood results were obtained from a previously fit and well patient undergoing a prolonged respiratory wean following an episode of severe community acquired pneumonia one month earlier.

Parameter	Patient Value	Adult Normal Range
Haemoglobin	78 g/L*	115 – 155
Haematocrit	0.20*	0.35 – 0.45
Mean Cell Volume	85 fL	80 – 99
Mean Cell Haemoglobin	28 pg	27 – 33
White Cell Count	15.3 x 10 ⁹ /L*	4.0 – 11.0
Neutrophils	12.0 x 10 ⁹ /L*	1.9 – 7.5
Platelets	758 x 10 ⁹ /L*	150 – 400
Reticulocyte count	40 x 10 ⁶ /L	30 – 130
Iron	8 µmol/L*	10 – 30
Ferritin	798 µg/L*	20 – 450
Transferrin saturation	0.10*	0.15 – 0.50
Vitamin B ₁₂	700 pmol/L	200 – 900
Folate	15 nmol/L	> 7
C-reactive protein	210 mg/L*	< 8
Albumin	25 g/L*	35 – 50

Interpret the abnormal results and justify your reasoning.

(40% marks)

ANSWER TEMPLATE

9.2

Normochromic normocytic anaemia of chronic disease with on-going inflammation NOT Fe deficiency anaemia because:

- Normochromic normocytic anaemia
- Low Fe
- Transferrin saturation mildly reduced
- Raised ferritin
- Raised CRP (inflammatory state)

9.3

With respect to the coagulation status of a third trimester pregnant patient compared to that in the non-pregnant state, indicate the change you would anticipate for each test listed below:

- a) Platelet count
- b) Factor V, VII, IX, X levels
- c) Fibrinogen level
- d) Protein S level

(20% marks)

ANSWER TEMPLATE

9.3

- a) Platelet count: Decrease
- b) Factors V, VII, IX, X level: Increase
- c) Fibrinogen level: Increase
- d) Protein S level: Decrease

Maximum Score	8.0
Percentage Passed	72.5%

Question 10

As a newly appointed Intensive Care Specialist, you are put in charge of Safety and Quality in your ICU. The infection control department informs you that your ICU has a higher than acceptable rate of central line associated blood stream infections (CLABSI).

- a) Define CLABSI rate. (10% marks)
- b) Outline your approach to this problem in terms of initial investigation and ongoing management and monitoring. (90% marks)

ANSWER TEMPLATE

- a) CLABSI rate = confirmed blood stream infections / central line days x 1000
i.e. Number of confirmed blood stream infections per 1000 central line days
CLABSI count and central line days defined by Australian Commission on Safety and Quality in Health Care
- b) The ANZICS CORE CLABSI Registry provides a national reporting and benchmarking system

Investigation

- Review data/audit to ensure counts are correct and that data quality issues are not responsible for a false estimation
- Review the cases of confirmed blood stream infection and ensure no false positives or negatives
- Review method of counting line days as missed days will result in artificially high rate
- Involve relevant stakeholders – nurses, infection control, ICU medical staff – and form working party
- Compare with historical CLABSI data for the unit – is this a spike or has it always been a problem
- Benchmark rate against published targets or benchmarked targets referenced against peer hospitals. Generally reported as number of infections per 1000 line days with expectation of rate <1/1000
- Ideally benchmark based on contemporary registry based data (ANZICS CORE CLABSI Registry) with risk adjustment although no risk adjustment exists within current reporting

Management

If increased rate confirmed investigate potential causes of high rate.

Implementation of specific strategies based on best available evidence and ideally as part of an established wider program.

Specifically:

- Staff training and use of correct aseptic technique (ANZICS Central Line Insertion and Maintenance Guideline)
- Insertion site selection
- Use of insertion bundle or checklist
- Consideration of limiting insertion to fewer more experienced operators (insertion team) with accreditation process
- Documentation of daily review of line
- Removal of all lines at earliest feasible time
- Specific evidence for
 - Use of antimicrobial impregnated lines and biopatches
 - Use of Chlorhexidine plus alcohol as disinfectant
- Consider alternatives to conventional CVC when possible e.g. PICC lines and tunneled lines

Ongoing monitoring

Audits of process such as observation of aseptic technique.

Ongoing monitoring of rates over time with review based on appropriate statistical process control to distinguish special cause from common cause variation. That is essentially to ensure that any change is statistically significant. For example:

- Funnel plots
- EWMA charts – exponentially moving weighted average

- CUSUM charts – cumulative sum control

Implementation and monitoring may require additional resources to be provided by administration (equipment, staff etc.)

Submission of data to ANZICS CORE CLABSI Registry

Regular reporting back to staff and hospital S&Q / infection control committee

Additional Examiners' Comments:

This was poorly answered overall; only a minority of candidates could correctly define CLABSI rate. Most candidates produced standard proforma answers that ignored specifics and could have been referring to any QI issue.

Maximum Score	7.0
Percentage Passed	52.5%

Question 11

The following table gives information on the proportions of a population that have been exposed to a risk factor for a disease and then subsequently developed the disease.

Exposure + Indicates the proportion exposed to the risk factor (A+B)

Exposure - Indicates the proportion not exposed to the risk factor (C+D)

Disease + Indicates the proportion that subsequently developed the disease (A+C)

Disease - Indicates the proportion that did not subsequently develop the disease (B+D)

	Disease +	Disease -
Exposure +	A	B
Exposure -	C	D

- Define prevalence **AND**, with reference to A, B, C, D in the table above, give the prevalence of the disease in this population. (20% marks)
- Define relative risk (RR) **AND**, with reference to A, B, C, D in the table above, derive the relative risk of developing the disease after exposure to the risk factor. (40% marks)
- Define attributable risk (AR) **AND**, with reference to A, B, C, D in the table above, give the attributable risk of exposure to the risk factor on developing the disease in this population. (40% marks)

ANSWER TEMPLATE

- Prevalence: number of event (e.g. disease) in a specific population at a particular time point.

Prevalence of the Disease in this population

$$\frac{A+C}{A+B+C+D}$$

- b) Relative risk is the ratio of the probability of an event occurring (e.g. developing a disease) in an exposed group to the probability of the event occurring in a comparison, in non-exposed group.

$$\frac{A/(A+B)}{C/(C+D)}$$

- c) Attributable risk is the difference in the rate of a condition between an exposed and unexposed population.

$$A/(A+B) - C/(C+D)$$

Maximum Score	9.2
Percentage Passed	45.0%

Question 12

Outline the pathophysiology, diagnosis and treatment of mesenteric ischaemia.

ANSWER TEMPLATE

Definition

Mesenteric ischaemia occurs when blood flow is inadequate to meet the metabolic demands of the small bowel or colon.

Pathophysiology

- Occlusion of the arterial supply leads to ischaemia of the mucosa, before progressing to full thickness ischaemia and infarction with subsequent bacterial translocation leading to localised abscess formation, peritonitis and systemic sepsis depending of the extent of ischaemia.
- Arterial embolism – generally originates from atrial thrombi and therefore tends to occur with tachyarrhythmias, cardiac failure or rheumatic heart disease
- Arterial thrombosis – occlusion of atherosclerotic mesenteric vessel
 - Dissection of the aorta
 - Torsion
 - Closed loop bowel obstruction (intraluminal pressure > arterial pressure)
 - Surgical misadventure
- Venous thrombosis – venous occlusion generally in prothrombotic state e.g.: factor deficiency, malignancy, abdominal trauma, closed loop obstruction
- Mesenteric ischaemia may also occur as a near terminal event in low cardiac output states with poor global oxygen delivery

Diagnosis

- History:
 - Acute onset of central colicky or constant abdominal pain, often associated with nausea, vomiting, and constipation
 - May have history of pre-disposing condition e.g.
 - Atrial fibrillation
 - Mechanical cardiac valve
 - Predisposing conditions for atherosclerosis
 - Previous bowel surgery

- Examination:
 - General
 - Often look unwell, tachycardiac (?AF) tachypnoeic (related to metabolic acidosis), hypotensive
 - Abdomen
 - At first may be soft and non-tender in spite of quite severe pain (while only mucosa is ischaemic) progressing then to localised or generalised peritonism
- Investigations:
 - Laboratory
 - Lactate is often raised but may be normal
 - Non-specific markers of inflammation
 - Plain AXR -Riegler's sign (gas on both sides of bowel wall), thickening of bowel wall
 - Ultrasound
 - May detect proximal vessel occlusion/narrowing
 - Images often inadequate due to pain, bowel gas, obesity etc.
 - CT
 - CT Angiography – information on vasculature as well indication of bowel injury (stranding, lack of enhancement, free air etc.)
 - Two phase imaging(contrast) for optimal venous images
 - Poor sensitivity
 - MRI
 - Good vascular images, but often unacceptable delay in image acquisition
 - Endoscopy
 - May identify ischaemic changes in bowel and rectum
 - Diagnostic surgery
 - May be only way to confirm diagnosis

Treatment

- General resuscitative
 - Fluid resuscitation and judicious vasoactive support
 - Anticoagulation – generally with heparin
 - Antibiotics – controversial but often given as gut translocation and perforation common
- Disease specific
- Arterial thrombus/embolism
 - Reperfusion
 - Endovascular – mechanical thrombectomy, angioplasty and stenting or thrombolysis
 - Requires close monitoring and often require laparotomy for peritonitis and bowel resection
 - Open
 - Revascularisation – thrombectomy and or arterial bypass
 - Assessment of bowel viability
 - Resection of necrotic bowel
 - Often require “second look” operation
- Venous thrombosis
 - Systemic anticoagulation
 - Consider percutaneous thrombectomy
 - Laparotomy for complications – peritonitis
- Low output state
 - Optimise haemodynamic stability
 - Minimising vasoconstrictors controversial
 - Laparotomy for complications – peritonitis

Additional Examiners' Comments:

The template above is only a guide to the expected answer.

Important points sought by the Examiners were: the different categories of mesenteric ischaemia, comments about importance of history, examination and suspicion; it was essential to mention surgery as a diagnostic tool.

Maximum Score	9.0
Percentage Passed	50.0%

Question 13

A 56-year-old female with idiopathic pulmonary fibrosis (IPF) is transferred to your ICU from a regional hospital having presented with an acute exacerbation and hypoxic respiratory failure. She has been intubated and ventilated, with SPO₂ 88% on a FiO₂ 1.0.

- a) Outline how you would optimise lung function in this patient. (50% marks)
- b) Outline the barriers to weaning from mechanical ventilation in this patient. (50% marks)

ANSWER TEMPLATE

a) Optimise lung function

- Look for and treat reversible features e.g. fluid overload, infection, bronchospasm, heart failure
 - Diuretics / fluid limitation
 - Appropriate antimicrobial treatment
 - Bronchodilators
- Disease modifiers – steroids, immunosuppressants, novel agents e.g. tyrosine kinase inhibitors
- Pulmonary vasodilators
- Lung protective strategies and be cautious about high PEEP as the more compliant part of the lungs may be over inflated
- Involvement of respiratory physicians
 - They may know the patient
 - Advice regarding prognostication
- V-V ECMO as bridge to transplantation, now being pursued in some centres

b) Outline the barriers to weaning in this patient with IPF?

- Oxygenation can be significantly impaired – set realistic goals of PaO₂ / SpO₂
- Compliance can be severely impaired affecting ventilator synchrony – leading to difficulties in sedation
- Spontaneous respiratory rate can be high, leading to staff wanting to increase analgesia / sedation
- Muscle strength can be poor
 - Progressive disease
 - Chronic malnutrition
 - Weakness exacerbated by steroids
 - CIPM
- Immunosuppression can lead to recurrent infections
- Pulmonary hypertension can lead to significant CVS dysfunction
- Patient cognition and emotional status
- Negative attitudes to a bad prognostic disease

Maximum Score	7.4
Percentage Passed	35.0%

Question 14

A 45-year-old male has been in ICU for 10 days for necrotising pancreatitis. He has been treated for eight days with vancomycin, meropenem and caspofungin in appropriate dosages. He has been febrile and hypotensive for 24 hours and has had a change in vascular access.

The following three scenarios describe different potential results from his blood cultures:

Scenario 1:

His blood cultures from the previous day become positive with a Gram-negative bacillus. The line tips show no growth.

- a) List four likely identities for the Gram-negative bacillus, **AND** give an appropriate choice of antimicrobial for each. (60% marks)

Scenario 2:

His blood cultures from the previous day become positive with a Gram-positive coccus. The line tips show no growth.

- b) List three likely identities for the Gram-positive coccus, **AND** give an appropriate choice of antimicrobial for each. (30% marks)

Scenario 3:

His blood cultures from the previous day become positive with a yeast.

- c) Give one likely identity for the yeast, **AND** suggest an appropriate antimicrobial agent. (10% marks)

ANSWER TEMPLATE

a) Scenario 1

- *Stenotrophomonas maltophilia*- environmental organism with low virulence
Treatment is cotrimoxazole, ticarcillin clavulanic acid
- Multi-resistant *Acinetobacter baumannii* Low virulence overall- though recent cases of high virulence community acquired cases in USA
Treatment is complex- Colistin, Tigecycline
- Multi-resistant *E.coli*
- Multi-resistant *K. pneumonia* (or metalloprotein betalactamase secreting GNB) – virulent with high mortality- combination treatment which includes carbapenem, colistin, rifampicin and tetracycline – new agents such as avibactam and cefiderocol show promise
- Multiresistant *Pseudomonas aeruginosa*
- Metalloprotein beta-lactamase secreting GNB
Acceptable answer
Treatment will depend on extended susceptibilities- colistin and amikacin are potential options

b) Scenario 2

- Vancomycin resistant *Enterococcus faecalis*
- Vancomycin resistant *Enterococcus faecium*
- Staphylococcus aureus with intermediate susceptibility to Vancomycin (VISA)
- Vancomycin resistant *Staphylococcus aureus* (VRSA) (*not yet reported in Australia but candidates should get credit if they mention it*)

Treatments include daptomycin, linezolid, tigecycline, ceftaroline

c) Scenario 3

- The likely yeast in this setting is *Candida glabrata* (would accept *Kruzei* or *Tropicalis*, or other resistant organism. Simply stating caspofungin resistant organism did not score marks), *Scedesporium* acceptable
- Treatment would be with Amphotericin

Maximum Score	8.3
Percentage Passed	65.0%

Question 15

(Images removed from report.)

You are called to review a 48-year-old male in the post-operative recovery unit (PACU) who has just undergone resection of a TSH-secreting pituitary adenoma via a trans-sphenoidal approach. He is febrile (38.5°C) and is hypertensive (160/50 mmHg) with tachycardia (130 beats/min) and hyper-dynamic circulation, and is hyper-reflexic.

- a) Give the likely diagnosis. (10% marks)
- b) List your immediate pharmacological management. (30% marks)

The patient subsequently recovered and was discharged home. He re-presented two weeks later with increasing drowsiness, confusion, fevers, neck stiffness and a clear nasal discharge.

- c) Give the likely diagnosis. (10% marks)
- d) Briefly outline your immediate management. (30% marks)

Three days after re-admission, the same patient was the subject of a Rapid Response System (RRS) call for decreased consciousness.

Images 1 and 2 (removed from report) are slices from the CT head scan taken at the time of this event.

- e) What complication has occurred? (20% marks)

ANSWER TEMPLATE

- a) Thyroid storm
- b) Propranolol 60-80mg 4-6 hourly (or other beta blocker) to control BP and HR
Propylthiouracil (200mg 4hrly) or Carbimazole 20-30 mg every 4-6 hours
Hydrocortisone 100mg 6hrly
- c) CSF leak post-surgery with meningitis
- d) Intubation for airway protection if indicated and ventilatory support
Haemodynamic resuscitation / support as indicated
Blood cultures
LP (post CT scan)
Broad-spectrum antibiotics with CNS penetration (e.g. meropenem and vancomycin)
Referral to neurosurgery / ENT
(ID input)

- e) Tension pneumocephaly (Mount Fuji sign) secondary to malpositioned nasopharyngeal airway tube

Maximum Score	8.5
Percentage Passed	80.0%

Question 16

A 65-year-old male with a past history of ischaemic heart disease is admitted to the ICU after a motorcycle crash having sustained long bone fractures of the lower limbs. He has no head, chest or abdominal injuries.

Prior to surgery, his Glasgow Coma Scale (GCS) was 15 and SpO₂ was 98% on 4 L/min oxygen via a Hudson mask, and chest X-ray was normal. He required prolonged operative fixation of his fractures and that was complicated by significant blood loss. Intra-operatively, he also developed an increasing oxygen requirement.

On arrival in ICU, his most recent arterial blood gas, taken on a FiO₂ of 0.7 shows PaO₂ of 55 mmHg (7.3 kPa).

- a) List the differential diagnoses for his respiratory failure. (30% marks)
- b) Outline the steps in your assessment of this patient to help determine the diagnosis. (70% marks)

ANSWER TEMPLATE

a) Differential diagnoses

- Iatrogenic fluid volume overload due to blood product/ resuscitation fluid
- Atelectasis/Collapse/ sputum plugging
- Unrecognised pulmonary contusions
- Unrecognised pneumothorax – Mech vent, line insertion
- Aspiration at time of MBA or at intubation
- Endobronchial intubation
- Transfusion related acute lung injury (TRALI)
- Cardiogenic pulmonary oedema/myocardial event
- Fat embolism syndrome
- Anaphylaxis
- PE

b) Assessment

- History
 - Details of accident
 - PMH
 - Allergies
- Clinical examination
 - Ensure adequate tertiary survey
 - Detailed respiratory examination
 - Review fluid balance and urine output
 - Evidence of generalised allergic reaction FBE – Hb, WCC, eosinophilia
- Investigations

- Coags – ongoing coagulaopathy,
- Chest XRay – infiltrates, ETT position, hardware, PTx, pleural effusions
- Cardiac enzymes – Tnl
- ECG – ischaemic changes, arrhythmia, R heart strain
- Echocardiogram – if suspect cardiogenic component, assess LVF, or RVF for PE
- CTPA – early for PE but possible if patient delayed in ED
- Bronchoscopy – if evidence of localised collapse or unexplained infiltrates

Maximum Score	7.8
Percentage Passed	90.0%

Question 17

Describe the advantages and disadvantages of the available methods for allowing speech in a patient with a tracheostomy tube *in situ*.

ANSWER TEMPLATE

1. Cuff deflation

Simple cuff deflation may allow patients to speak.

- *Advantages*
 - Simple, no additional equipment required
 - Can allow mechanical ventilation to continue
- *Disadvantages*
 - May compromise gas exchange
 - Aspiration risk
 - Patient may not be able to generate sufficient air flow if large diameter trache tube in situ
 - Loss of PEEP

2. Capping tube

Cuff is deflated and patient or caregiver places finger over tracheostomy tube.

- *Advantages*
 - Simple, no additional equipment required
- *Disadvantages*
 - Does not allow mechanical ventilation to continue
 - Patient may not manage with increased resistance to expiration
 - Requires patient or caregiver to manually occlude tube

3. Speaking valve e.g. Passy Muir

One-way valve attached to tracheostomy tube.

Gas enters tracheostomy during inspiration but is directed through larynx in expiration.

- *Advantages*
 - Simple, tube change not required
 - Can allow mechanical ventilation to continue
 - Provide some PEEP
- *Disadvantages*
 - Requires cuff deflation – aspiration risk
 - **Risk of airway obstruction and death if cuff left inflated (major point in marking)**
 - Loss of humidification

- Dependant on tube size, laryngeal size, patient may not manage with increased resistance to expiration

4. Sub glottis air insufflation e.g. Pitt tube/Speaking Tube

Gas line with an outlet above the cuff and a thumb port. Patient or caregiver can occlude the port which directs gas through the larynx allowing speech.

- *Advantages*
 - Can allow mechanical ventilation to continue
 - Cuff remains inflated reducing risk of aspiration
- *Disadvantages*
 - Requires tube change (unless inserted initially)
 - Voice quality poor
 - Requires practice by patient
 - Can be uncomfortable
 - Needs someone to occlude port

5. Fenestrated tube

Specialised tube with fenestration and inner cannula that allows gas to pass to larynx when tube occluded.

- *Advantages*
 - Inner cannula can be swapped for non-fenestrated if mechanical ventilation required
 - Can be used with cuff inflated if aspiration risk
 - Allows suction of secretions
- *Disadvantages*
 - May require tube change if not inserted originally
 - Increases work of breathing
 - Fenestrations may occlude leading to obstruction risk
 - Difficult to get fenestrations of tube and inner cannula to line up

6. Electronic larynx

Specialised equipment that is held to patient's neck and vibrates when activated and mechanically resonates when words or sounds are mouthed. Uncommon in ICU but has been described.

Additional Examiner Comments:

This was answered poorly. Several candidates failed to mention that the cuff must be deflated prior to use of a speaking valve; this omission could lead to serious clinical consequences.

Maximum Score	7.0
Percentage Passed	37.5%

Question 18

A 78-year-old female is admitted to ICU following aortic valve replacement for severe aortic stenosis. Her co-morbidities include ischaemic heart disease, peripheral vascular disease, hypertension, type 2 diabetes, emphysema and chronic kidney disease.

The operation was prolonged and difficult requiring repair of a right ventricular injury and emergency coronary artery bypass graft. The patient required adrenaline, noradrenaline and an intra-aortic balloon pump to separate from cardiopulmonary bypass.

At 4 hours post-operatively, she becomes progressively more hypotensive with increasing noradrenaline doses.

- a) List the potential causes for her shock state. (60% marks)
- b) With respect to severe aortic stenosis, list the available alternatives to open valve replacement, with the respective advantages and disadvantages. (40% marks)

ANSWER TEMPLATE

a) Hypovolaemic

- Bleeding

Cardiogenic

- Acute MI
- Graft obstruction
- Diastolic dysfunction
- RV failure
- Pacing problem
- Pulmonary hypertension

Distributive

- Long bypass time
- Occult sepsis (e.g. GI tract ischaemia)
- Relative adrenal dysfunction
- Nutritional deficiency

Obstructive

- Pericardial tamponade
- Left Ventricular Outflow Tract Obstruction
- Prosthetic valve obstruction
- Tension Pneumothorax (may be loculated due to previous surgery)
- IABP failure / dyssynchrony/ malposition

Combination of above e.g. Aortic dissection

- b) Medical management only +/- palliation. Considered if prognosis of comorbidities is worse than natural history of AS. Avoids risks of surgery.

Medical management + balloon valvuloplasty. BAV may provide some symptomatic benefit albeit at the risk of complications from femoral vessels/ annular rupture. May also be useful diagnostically to see if dyspnoea improves.

TAVI – femoral access probably unlikely to be possible due to PVD, transapical or transaortic much higher risk but possible. Less invasive.

Maximum Score	9.0
Percentage Passed	80.0%

Question 19

You are preparing to intubate a morbidly obese patient for respiratory failure.

Describe the strategies for minimising hypoxaemia in the period immediately pre- and post-intubation.

ANSWER TEMPLATE

Ensure optimal treatment of the underlying cause of respiratory failure where possible, e.g.

- Diuretics and CPAP for acute pulmonary oedema
- Bronchodilators for asthma

1. Optimise pre-oxygenation/ intra procedure oxygenation

- Longer time of pre-oxygenation
- Use of PSV or CPAP pre-intubation (peak Pi not >15 cmH₂O recommended)
- Nasal prong and/or high-flow oxygenation during intubation (e.g. THRIVE or simple prongs at 15l/min)
- Monitoring end tidal oxygen; target FeO₂ >80%

2. Minimising time to first breath

- Positioning (*essential point to mention*)
- Ramping (*or similar*) achieving tragus-sternal angle in horizontal plane Important in obese patient
- Experienced operator
- Equipment ready (*expect candidate to have fall-back equipment such as VL, bougies, second generation LMA. No specific right or wrong re which device they should use first*)
- Use of rapidly acting skeletal muscle relaxant (or use of spontaneously breathing technique e.g. LA)
- Monitoring for intra-tracheal placement of ETT; capnography
- Ventilator set up with appropriate settings for immediate use including FiO₂ 1.0 and appropriate level PEEP, Vt and inspiratory airway pressure
- Teamwork management – clear roles in primary and backup plans
- NB: Delay with use of video-laryngoscopy

3. Rescue strategies

- Plan A, Plan B, Plan C
- Preparations for supraglottic and infraglottic rescue (*more credit if specific algorithm is mentioned e.g. Vortex, DAS*)

4. Optimise cardiac output for improved V/Q matching

- Judicious fluid loading
- Vasopressors (e.g. Nor-adrenaline, metaraminol)
- Awareness of fall in output with induction of anaesthesia and institution of IPPV
- Invasive arterial pressure monitoring

Maximum Score	8.0
Percentage Passed	62.5%

Question 20

20.1

The following venous blood results are from a 56-year-old patient presenting with abdominal pain.

Parameter	Patient Value	Adult Normal Range
Sodium	130 mmol/L*	135 – 145
Potassium	5.1 mmol/L*	3.5 – 5.0
Chloride	101 mmol/L	95 – 105
Bicarbonate	10 mmol/L*	22 – 28
Creatinine	305 µmol/L*	50 – 100
Urea	75.6 mmol/L*	3.5 – 7.2
Glucose	5.2 mmol/L	3.5 – 6.0
Calcium corrected	2.05 mmol/L*	2.12 – 2.62
Ionized Calcium	0.97 mmol/L*	1.14 – 1.30
Phosphate	3.97 mmol/L*	0.73 – 1.37
Protein	66 g/L	61 – 83
Albumin	29 g/L*	35 – 50
Alkaline phosphatase	220 U/L*	30 – 110
γ-Glutamyl transferase	30 U/L	< 40
Alanine transferase	27 U/L	< 35
Magnesium	0.83 mmol/L	0.75 – 0.95

Interpret the biochemical results, giving underlying reasons to explain the abnormalities.

(40% marks)

ANSWER TEMPLATE

20.1

- Chronic renal failure with secondary hyperparathyroidism
- Elevated urea and creatinine
- Decreased calcium, raised ALP and phosphate
- Dehydration or GI bleed
- Raised U:Cr
- Mixed HAGMA and NAGMA
- Low HCO₃ and delta ratio >1
- Chronic renal failure (uraemia and RTA)
- Acute on chronic renal failure (sepsis, dehydration, GI bleed etc.)

(Other reasonable explanations were accepted.)

20.2

A 46-year-old male presents with vomiting for the past five days. His arterial blood gas result on room air is shown below:

Parameter	Patient Value	Adult Normal Range
pH	7.74*	7.35 – 7.45
pCO ₂	48.5 mmHg (6.4 kPa)*	35.0 – 45.0 (4.6 – 6.0)
pO ₂	80 mmHg (10.5 kPa)	80 – 100 (10.5 – 13.0)
Bicarbonate	62 mmol/L*	20 – 30

Base Excess	39.6 mmol/L*	-2.0 – +2.0
SpO ₂	97.6%	95.0 – 98.0
Sodium	131 mmol/L*	135 – 145
Potassium	3.1 mmol/L*	3.5 – 5.0
Chloride	47 mmol/L*	95 – 105
Glucose	10.5 mmol/L*	3.5 – 6.0
Lactate	5.6 mmol/L*	< 2.0

Describe the acid-base derangements seen.

(30% marks)

ANSWER TEMPLATE

20.2

- Profound metabolic alkalosis with inadequate respiratory compensation
- Lactic acidosis (raised anion gap)

20.3

The following arterial blood gas result was obtained from a 70-year-old female with type 2 diabetes, presenting with acute exacerbation of asthma.

Parameter	Measured Value	Adult Normal Range
FiO ₂	0.21	
pH	7.21*	7.35 – 7.45
PaCO ₂	60 mmHg (8.0 kPa)*	35 – 45 (4.6 – 6.0)
PaO ₂	55 mmHg (7 kPa)	
Bicarbonate	23 mmol/L	22 – 27
Base Excess	-4 mmol/L*	-2 – +2
Sodium	135 mmol/L	135 – 145
Potassium	5.3 mmol/L*	3.5 – 5.0
Chloride	100 mmol/L	100 – 110
Glucose	9.2 mmol/L*	3.5 – 6.0
Urea	8.3 mmol/L*	3.5 – 7.2
Creatinine	120 µmol/L*	50 – 100
Lactate	4.8 mmol/L*	< 2.0
HbA1c	110 mmol/mol*	50 – 60

Describe the abnormalities in the above results, giving likely explanations.

(30% marks)

ANSWER TEMPLATE

20.3

- Normal A-a gradient (20) for 70 year old – hypoventilation
- Respiratory acidosis – acute type 2 respiratory failure tiring from acute asthmatic attack
- Normal anion gap metabolic acidosis – underlying type IV RTA secondary to diabetic nephropathy (or any reasonable cause)
- Hyperlactataemia – beta-2 agonist induced
- Hyperkalaemia and raised creatinine- renal impairment
- Poor diabetic control (high BSL and HbA1C)

Maximum Score	7.3
Percentage Passed	72.5%

Question 21

You are the leader on the retrieval team for a patient with cerebral arterial gas embolism (CAGE) following a scuba diving accident to your regional Hyperbaric Centre, 300 km away. The patient is intubated, ventilated and on vasopressors.

Outline the strategies needed in preparation, planning and implementation to ensure safe transport of the patient, including the necessary strategies for the patient's specific condition.

ANSWER TEMPLATE

A. General; compliance with CICM/ANZCA/ACEM guideline;

Possible clinical impact of the transport environment (in this case flight environment may be particularly deleterious if patient is exposed to sub-atmospheric pressure).

- Urgency of intervention – urgent
 - Road transport times and road conditions
 - Weather conditions and aviation restrictions for airborne transport
 - Aircraft landing facilities
 - Range and speed of vehicle
- a) Team with suitable training and experience
- Clinical – adequate seniority
 - Logistic – aircraft safety training and familiarity with transport equipment/environment
- b) Equipment- appropriate ventilator, monitors, alarms, devices for manual handling, pumps to maintain infusions. Full list from the CICM guideline not required but key elements needed
- Respiratory support equipment (doesn't need extensive expansion other than ventilator, manual ventilation equipment, appropriate gear for reintubation)
 - Circulatory support equipment:
 - Monitor/defibrillator/external pacer combined unit
 - Multifunction monitor including capnograph
 - Intravenous fluids and pressure infusion set
 - Infusion pumps
 - Syringes and needles
 - Pericardiocentesis and thoracostomy equipment
 - Other equipment:
 - Personal protective equipment
 - Nasogastric tube and bag
 - Urinary catheter and bag
 - Thermal insulation and temperature monitor
 - Consideration should be given to alternative vascular access such as intraosseous devices
- c) All drugs should be checked and clearly labelled prior to administration. The range of drugs available should include all drugs necessary to manage acute life-threatening medical emergencies and those specific to the patient's clinical condition
- d) Liaison with the receiving centre ensuring key details have been conveyed, especially relevant in this case
- e) Final preparation of the patient should be made prior to transport, with anticipation of clinical needs. Examples include giving appropriate doses of muscle relaxants or sedatives, replacing

near-empty inotrope and other intravenous solutions with fresh bags, and emptying drainage bags.

B. Specific to condition;

Need to consider mode of transport

- 300km essentially obviates road
- Fixed wing has potential for sea level cabin but requires increased handling
- Helicopters not pressurised and may not be suitable unless terrain allows low-level flight

The candidates needed to be aware that minimal cabin altitude is a key part of management.

- Airway
 - ETT secured, CXR to confirm the position
 - May need suctioning if prolonged delay to retrieval
- Ventilation
 - 100% FiO₂
 - Minimise PEEP (5cm H₂O)
 - Check ABG, and ventilate at TV 6-ml/kg, SIMV, rate to maintain normocarbida
 - CAGE may be associated with other barotrauma so CXR to exclude pneumothorax
- Circulation
 - Try to maintain euvolaemia
 - As on vasopressors will need CVC. CVC needs to be well secured. Probably dilute vasopressors according to retrieval regimen to ensure smooth transition
- Neurological
 - Maintain normothermia
 - Will need sedation and paralysis for transport, again dilutions as per retrieval
 - Regular check of BSL, aim 6-10
 - Should have CT to exclude differential diagnosis. Copy will need to go with patient (hard copy or digital copy)

C. Interim management in liaison with hyperbaric unit

Additional Examiners' Comments:

This answer template is long and detailed and it was not expected that candidates needed to reproduce it all to obtain a pass. Important points were the awareness and compliance with guidelines on transport of critically ill patients, and the awareness that minimising flight altitude is essential.

Maximum Score	7.3
Percentage Passed	32.5%

Question 22

(Images removed from report.)

Please note for all sections in this question, the following apply to the ventilator waveforms depicted:

<i>Top Waveform</i>	<i>Airway Pressure (cmH₂O)</i>
<i>Middle Waveform</i>	<i>Flow (L/min)</i>
<i>Bottom Waveform</i>	<i>Tidal Volume (mls)</i>

22.1

The following ventilator waveforms shown below (*image removed*) are from a female patient, ventilated with a volume preset assist control mode for severe respiratory failure. Her predicted body weight is 55 kg and her arterial oxygen saturation is 97%.

- a) Give the likely lung disease for which the patient is being ventilated. (10% marks)
- b) Give three features from this scenario that supports your diagnosis. (30% marks)

ANSWER TEMPLATE

22.1

- a) Asthma
- COPD (Although pressures of 68 cmH₂O unusual in COPD)
- b) High peak airway pressure
- High peak-plateau pressure difference
 - Continuing expiratory flow at the end of expiratory time (alternatively, 5 l/min flow at end-expiration)
 - Oxygen requirements (FiO₂ 0.4) not very high for a patient who requires mechanical ventilation
 - PEEP zero

22.2

The following ventilator waveforms shown below (*image removed*) are from a patient who is sedated, paralysed and ventilated in a pressure regulated volume control mode (pressure control mode with a target tidal volume). The patient has a history of bronchiectasis.

Give the most likely cause for the abnormal oscillations in the waveforms. (10% marks)

ANSWER TEMPLATE

22.2

Secretions in ETT or fluid in circuit.

22.3

The following ventilator waveform shown below (*image removed*) is from a patient who is sedated and ventilated in the pressure regulated volume control mode (a pressure control mode with a target tidal volume). The patient has an arterial oxygen saturation of 94%.

- a) Give the likely lung pathology. (10% marks)
- b) Give two features shown in the flow waveform that support your answer. (20% marks)

ANSWER TEMPLATE

22.3

- a) Less than 24 cm H₂O.

Flow has not reached zero by the end of inspiration indicating there is still a pressure gradient between the ventilator and the alveoli. As result the alveolar pressure must be less than the inspiratory pressure delivered by the ventilator.

[Note: 24 was not an acceptable answer]

- b) Obstructive airways disease
High inspiratory flow at the end of inspiration despite adequate inspiratory time
Failure of expiratory flow to return to zero by the end of expiration

22.4

The following ventilator waveform shown below (*image removed*) is from a patient who is sedated and ventilated in the pressure regulated volume control mode (a pressure control mode with a target tidal volume). The patient has an arterial oxygen saturation of 94%.

- a) Give the likely underlying lung pathology. (10% marks)
- b) Give one feature shown in the flow waveform that supports your answer. (10% marks)

ANSWER TEMPLATE

22.4

- a) Any lung pathology associated with poor compliance such as severe restrictive pathologies
- b) Inspiratory flow drops sharply very early in inspiration

Maximum Score	7.8
Percentage Passed	72.5%

Question 23

With respect to hypocaloric enteral nutrition in the critically ill:

- a) Explain the following terms:
 - i. Trophic feeding
 - ii. Permissive underfeeding (40% marks)
- b) Outline the potential advantages of hypocaloric enteral nutrition and the available evidence for its use (60% marks)

ANSWER TEMPLATE

Trophic feeding refers to enteral feeding below the minimum required caloric intake, with the aim of maintaining gut integrity rather than meeting patient’s nutritional requirements. Definition of volume feed/energy required varies. Between 10-30ml/hr or 15-25% of calculated caloric intake. Can’t be used as sole nutritional strategy long term.

Permissive underfeeding is the provision of a reduced non-protein caloric target (around 40-60% of calculated total) hypothesizing that lower non-protein calorie intake may be beneficial. May be used as sole nutritional strategy.

Trophic feeding

Advantages of trophic feeding

Include potential beneficial effects on the gut such as preserving intestinal epithelium, stimulating secretion of brush border enzymes, enhancing immune function, preserving epithelial tight cell junctions, and preventing bacterial translocation. Could be considered in patients unable to tolerate full enteral nutrition. May minimise complications associated with full enteral feeding such as feed intolerance, aspiration, high gastric volumes, and diarrhoea.

Available evidence for trophic feeding

2 RCT's of patients with respiratory failure/ARDS (largest = EDEN trial JAMA 2012)

- Trophic feeding for up to 6 days does not improve ventilator free days, 60 day mortality or infectious complications.
- Less feed intolerance with trophic feeding (e.g. less prokinetic agents, vomiting, gastric residual volumes, lower GI symptoms),
- lower blood glucose, less insulin requirement

Permissive underfeeding

Advantages of permissive underfeeding

- Based on the premise that ideal caloric targets for critically ill patients are unknown, calorie restriction is associated with increased longevity in animal models, and may have beneficial effects on critically ill patients via hormonal or metabolic pathways
- May be established with either enteral or parenteral routes
- Avoids delivery of large volumes that may predispose to fluid overload
- If tolerated may avoid other strategies such as placement of NJ tube, prokinetics

Available evidence for permissive underfeeding:

- Arabi et al, (PermiT trial) NEJM 2015
- Randomised >800 patients to permissive underfeeding vs. standard care. No difference in mortality, feeding intolerance or diarrhoea

Specific trials not needed for pass.

Additional Examiners Comments:

This question was answered poorly. The majority of candidates were unable to accurately describe or define the two feeding strategies. There was limited appreciation of the available evidence.

Maximum Score	6.0
Percentage Passed	17.5%

Question 24

A 53-year-old known type 1 diabetic male is brought to the Emergency Department (ED) by ambulance after being found collapsed at home. His arterial blood gas result on admission is shown below:

Parameter	Patient Value	Adult Normal Range
FiO ₂	0.21	
pH	6.84*	7.35 – 7.45
pCO ₂	8.7 mmHg (1.1 kPa)*	35.0 – 45.0 (4.6 – 6.0)
pO ₂	80 mmHg (10.5 kPa)	
Bicarbonate	1.4 mmol/L*	22.0 – 26.0
Sodium	126 mmol/L*	135 – 145
Potassium	5.5 mmol/L*	3.5 – 5.2

Chloride	98 mmol/L	95 – 105
Glucose	54.0 mmol/L*	3.5 – 6.0
Lactate	4.1 mmol/L*	< 2.0
Haemoglobin	96 g/L*	115 – 160
Creatinine	150 µmol/L*	45 – 90

He has a Glasgow Coma Scale (GCS) of 12 (E4 V3 M5) and is uncooperative, agitated and combative. The ED Registrar suggests intubating the patient.

- a) Outline your immediate management of this patient. (80% marks)
- b) List the risk factors for all patients that predispose to the development of cerebral oedema in this condition. (20% marks)

ANSWER TEMPLATE

- a)
- The first priority is to prevent intubation. Induction will reduce minute ventilation and worsen acidosis with a probably fatal result. Many ED ventilators would struggle to provide 40 Lpm ventilation and the PPV in a severely hypovolaemic patient may cause haemodynamic collapse. Avoid sedation. Acidosis should resolve rapidly with fluid resuscitation and insulin.
 - IV line and fluids – preferably HCO₃⁻ containing to minimise hyperchloraemic acidosis (note CVC is optional) e.g. CSL. Water deficit around 4L for 70 kg man
 - IV insulin infusion (suggest 2-5 U/hr) with hourly glucose monitoring. Institute IV glucose once BGL < 12, and continue insulin until ketones cleared and beyond
 - Hourly K⁺ and early replacement – watch for massive drop as pH rises
 - Replace other electrolytes as needed (Mg, PO₄)
 - Check for precipitants esp. intoxication and infection
 - Investigate cause of anaemia
 - Disposition to appropriate high-care area (HDU/ICU/other)
- b)
- Younger age (especially under 5's)
 - Newly diagnosed diabetes
 - Severity of acidosis & hyperglycaemia
 - Severity of dehydration
 - Change in corrected [Na]
 - Speed of rehydration & correction of hyperglycaemia
 - Administration of bicarbonate

Additional Examiner Comments:

Many candidates stated they would intubate the patient; this would likely have precipitated a cardiac arrest due to acute rise in CO₂ and worsening acidosis.

Maximum Score	6.6
Percentage Passed	30.0%

Question 25

With respect to trans-pulmonary pressure (TPP):

- a) Explain what is meant by the phrase “trans-pulmonary pressure (TPP)”. (10% marks)

- b) Describe the technique of measurement, including any limitations. (30% marks)
- c) Discuss the rationale for its clinical use. (40% marks)
- d) Briefly outline the evidence for its role in the management of patients with acute respiratory distress syndrome (ARDS). (20% marks)

ANSWER TEMPLATE

TPP

TPP is the difference between the alveolar pressure (Palv) and pleural pressure (Ppl).
 TPP is the net distending pressure applied to the lung.

Rationale for TPP measurements

By measuring TPP the effects of chest wall compliance are negated and a true measure of lung distension is obtained. This may allow the safe tolerance of higher plateau pressures; with the assumption that it is lung distension that is important in generating lung injury

Current therapies target Paw (<30 cmH₂O) to minimise volutrauma or barotrauma. More accurate prevention of ventilator associated lung injury may be obtained by using TPP, e.g.:

- Limit recruitment maneuvers to TPP 25 cmH₂O
- Setting PEEP to TPP 0-10 cmH₂O
- Limiting volutrauma by setting VT to a TPP 25 cmH₂O
- Determination of respiratory muscle work in spontaneous ventilation
- Assessment of ventilator dys-synchrony
- Estimation of auto-PEEP in spontaneously breathing patients

Measurement

In ventilated patients Ppl is estimated from oesophageal pressure (Pes.) with a thin wall latex oesophageal balloon inserted via the NG or OG route. Its measurement is prone to error.

- Malposition – gastric (one of third balloon placements in study below challenging)
- Positioning: supine vs erect (addition of mediastinal weight)
- Assumption that pleural pressures even through the chest
- Extrinsic factors – obesity, rising intra-abdominal pressure

Measurement is automated on some ventilators.

Palv difficult to measure instantaneously during flow, but equalises to airway pressure at states of zero flow with airway occluded. Classically measured as inspiratory pause pressure after complete tidal volume.

Evidence, Talmor, NEJM 2008

61 patients ARDS / ALI – ARDSNet vs TPP targeted ventilation

- TPP group had higher PEEP, better oxygenation, higher Pplat
- Trends to better compliance, better mortality

No established role in general management.

May have a role in obesity, raised intra-abdominal pressure and air trapping.

Other techniques can compensate for inability to measure TPP e.g. best PEEP may be estimated by measuring respiratory compliance or oxygenation during a recruitment manoeuvre.

Amato's re-analysis of the ARDS net data showed convincingly that total respiratory driving pressure (Pplat-PEEP) correlated most strongly with mortality. Total respiratory driving pressure may correlate with TPP.

Additional Examiners' Comments:

Many candidates had little/no concept of either the utility or rationale for measuring transpulmonary pressure. Candidates confused terminology when discussing pleural pressure and alveolar pressure and could not give precise definitions.

Maximum Score	6.0
Percentage Passed	22.5%

Question 26

A 65-year-old male with a severe hypoxic brain injury following an out of hospital cardiac arrest has been in your ICU for eight days. The only evidence of neurological activity is that he takes an occasional breath whilst on the ventilator. The decision has been made to withdraw treatment on the grounds of futility. You consider him to be a candidate for donation after cardiac death (DCD). The family has indicated that they support a previously expressed desire by the patient to donate his organs should such a situation arise.

Outline the points that should be discussed with the family concerning the process of DCD.

ANSWER TEMPLATE

NB: Different states have different legislation and practices.

- Treatment withdrawal in patient's best interest
- Discuss the process of treatment withdrawal including the location where treatment withdrawal will occur (ICU, OT or a room next to the OT etc.) as well as the family's ability to be present until shortly after death
- Organ retrieval will need to occur very shortly after death thus limiting the time that the family can spend with their loved one after death has occurred
- Any medications including anxiolytics and analgesics can be administered at any time up until death to ensure patient comfort
- Predicting the time of death is very difficult, and, if it does not occur in a time frame, it may preclude organ donation but tissue donation is still a possibility
- The organs that can be donated will also be dependent on the time from withdrawal of treatment to death
- If organ donation is not possible because death has not occurred within the time frame, then the care of the patient will be continued either within the ICU or another suitable location
- Family consent will need to be gained for bloods to be taken for tissue typing and serology as well as for any procedures that need to be done to assess organ suitability, e.g. bronchoscopy, femoral catheters
- Organ removal surgery may reveal medical reasons for organ donation not to proceed
- Depending on the circumstances surrounding the cardiac arrest, there may be a need to refer the case to the Coroner who may decide on a post-mortem examination
- The family has the right to withdraw consent at any time

Maximum Score	7.5
Percentage Passed	72.5%

Question 27

Critically evaluate the role of induced hypothermia in the management of traumatic brain injury.

ANSWER TEMPLATE

Induced hypothermia refers to the use of techniques to intentionally lower the core body temperature below a physiological level (i.e. <36 degrees), in this case, in a patient with a traumatic brain injury.

Rationale

- Reduction in metabolic rate
- Reduction in oedema
- Modification of the inflammatory response

Indications

Prophylactic (early)

Therapeutic (for the management of elevated intracranial pressure)

Advantages

- Reduction in core body temperature is associated with a reduction in cerebral metabolic rate and reduction in cerebral blood flow
- Will be associated with a reduction in intracranial pressure
- Noted cerebral protective effect in animal models and in case reports of survival with good neurological recovery in hypoxic ischaemic encephalopathy in patients with severe accidental hypothermia
- Known that hyperthermia is associated with worse neurological outcomes

Adverse effects

- Requires sedation and neuromuscular blockade with the attendant adverse effects
- Lower temperature predisposes to infective complications, in particular pneumonia
- Coagulopathy
- Cardiac dysrhythmias
- Overshoot can expose patients to adverse effects of more severe hypothermia
 - Dysrhythmia
 - Diuresis and electrolyte disturbance
 - Immune suppression
- Adverse effects of cooling devices (loss of skin integrity) and monitoring devices (epistaxis)
- Cost of prolonged ICU stay and increased requirement for intervention and monitoring

Evidence

- Initial studies and meta-analysis showed promising results with regards to improved neurological outcomes
- Subsequent studies are less positive

Cochrane Systematic Review 2009

No evidence of benefit.

Significant benefit shown in low quality trials with tendency to over-estimate the treatment effect

Prophylactic Hypothermia:

- Nine class I and II studies, and 3 Class III studies summarised in BTF.
- Since then two paediatric studies and a Japanese study have been published

Brain Trauma Foundation (2016):

“Level II B: Early (within 2.5 hours), short-term (48 hours post-injury) prophylactic hypothermia is not recommended to improve outcomes in patients with diffuse injury”.

Elevated ICP management:

- EUROTHERM-3235 study
 - Induced hypothermia has an effect on reducing intracranial pressure, but the effect on outcome is variable
 - Little clinical evidence on the effect on other important aspects of cerebral physiology e.g. cerebral blood flow or cellular metabolism

Summary

- It is important to avoid hyperthermia
- Routine use of induced hypothermia in all TBI patients is not warranted
- Careful reduction in core body temperature may help control ICP in selected severe TBI patients who may otherwise be at risk of a decompressive craniectomy.
- Await results of high-quality RCTs

Maximum Score	8.5
Percentage Passed	70.0%

Question 28

This question relates to the critically ill obstetric patient.

- a) List the diagnostic criteria for peri-partum cardiomyopathy. (30%marks)
- b) With respect to amniotic fluid embolism (AFE):
- i. List six important risk factors. (30% marks)
- ii. Outline the important clinical features. (40% marks)

ANSWER TEMPLATE

- a)
- Onset of heart failure in the last month of pregnancy or within 5 months post-partum
 - Absence of an identifiable cause of heart failure
 - Absence of recognizable heart disease prior to the last month of pregnancy
 - LV systolic dysfunction demonstrated by classical echocardiographic criteria. The latter may be characterized as an LV ejection fraction < 45%, fractional shortening < 30%, or both, with or without an LV end-diastolic dimension 2.7 cm/m^2 body surface area. (*This level of detail not expected*)
- b)
- i. List six important risk factors
- Precipitous or tumultuous labour.
 - Advanced maternal age.
 - Caesarean and instrumental delivery.
 - Placenta previa and abruption.
 - Grand multi-parity (≥ 5 live births or stillbirths),
 - Cervical lacerations.
 - Foetal distress.
 - Eclampsia.

- Medical induction of labour.
 - Polyhydramnios
- ii. Outline the important clinical features of amniotic fluid embolism
- The onset of the symptoms and signs of amniotic fluid embolism syndrome (AFES) most commonly occurs during labour and delivery, or immediately postpartum
 - Non-specific symptoms – chills, nausea, vomiting, agitation
 - Hypotension due to cardiogenic shock
 - Hypoxemia and respiratory failure
 - Disseminated intravascular coagulation
 - Coma or seizures

Maximum Score	8.3
Percentage Passed	77.5%

Question 29

A 65-year old male has been admitted to ICU needing invasive mechanical ventilation following two episodes of generalised tonic-clonic convulsions and vomiting after an episode of suspected self-harm.

He has a history of hypertension, chronic obstructive pulmonary disease (COPD) and depression. His medications include Ramipril, Fluoxetine, Metoprolol, Theophylline and Fluticasone/Salmeterol inhaler.

His vital parameters are as follows:

Temperature 36°C
 Blood Pressure 85/46 mmHg
 SpO₂ 97% (FiO₂ = 0.35)
 ECG Atrial flutter with ventricular rate of 150 beats/min, normal QRS-duration and QTc interval.

His CT brain scan did not reveal any abnormality.

Results of his biochemistry are as follows:

Parameter	Patient Value	Adult Normal Range
Sodium	136 mmol/L	135 – 145
Potassium	2.9 mmol/L*	3.5 – 5.5
Chloride	105 mmol/L	92 – 107
Bicarbonate	10.9 mmol/L*	22.0 – 28.0
Urea	19.7 mmol/L*	2.5 – 6.5
Creatinine	220 µmol/L*	45 – 90
Magnesium	0.55 mmol/L*	0.65 – 1.00
Phosphate	0.55 mmol/L*	0.75 – 1.50
Corrected Calcium	2.67 mmol/L*	2.15 – 2.55
Creatinine Kinase	150 U/L	55 – 170
Blood Glucose	15.2 mmol/L*	3.5 – 6.0
Lactate	4.9 mmol/L*	< 2.0

a) Give the most likely diagnosis **AND** your reasoning. (40% marks)

b) Briefly outline your therapeutic strategies for this patient.

(60% marks)

ANSWER TEMPLATE

a)

- *Acute Theophylline Poisoning.* The clinical findings of vomiting, seizures, hypotension, Atrial Flutter combined with metabolic abnormalities strongly suggests theophylline poisoning
- Above biochemical abnormalities may suggest β -agonist toxicity; but cardiac arrhythmias and seizures are rare features of β -agonist toxicity
- Biochemical findings and ECG abnormalities do not favour tricyclic anti-depressant or SSRI overdose

b)

- Check serum theophylline
- Repeated doses of activate charcoal, as means of decontamination. Theophylline is also more rapidly cleared from the blood in patients receiving activated charcoal
- Extracorporeal removal such as charcoal hemoperfusion or hemodialysis, as theophylline has low volume of distribution without extensive protein binding. High efficiency hemodialysis as effective as charcoal hemoperfusion
- Control of seizures with benzodiazepines. Phenytoin should be avoided as it is not effective and may worsen mortality
- Correction of electrolyte abnormalities (hypokalemia, hypomagnesemia and hypophosphatemia)
- IV Esmolol or amiodarone for cardiac arrhythmia, after correction of electrolyte abnormalities
- Hypotension should be treated with IV fluids and/or noradrenaline. IV propranolol or esmolol may reverse hypotension as it is caused by β 2-adrenergic effects
- Hypercalcemia usually responds to fluid resuscitation
- Hyperglycemia responds to fluids and/or insulin administration

Additional Examiner Comments:

Several candidates failed to recognise theophylline poisoning. Many candidates failed to read the stem and did not give a rationale for their diagnosis. Management of theophylline toxicity was discussed poorly.

Maximum Score	7.0
Percentage Passed	40.0%

Question 30

30.1

List six clinical features associated with myotonic dystrophy.

(30% marks)

ANSWER TEMPLATE

30.1

- Frontal baldness
- Myotonic facies
- Wasting of facial muscles, sternocleidomastoids, muscles of distal extremities
- Myotonic spasms (e.g. delay in opening fingers after making a fist)

- Percussion myotonia
- Cardiomyopathy
- Cataracts
- Testicular atrophy
- Slurred speech (pharyngeal myotonia)
- Intellectual impairment
- Absent reflexes

30.2

(Image removed from report.)

- a) Give the diagnosis. (10% marks)
- b) List three associated biochemical abnormalities. (30% marks)

ANSWER TEMPLATE

30.2

- a) Acromegaly
- b) Hyperglycaemia (Diabetes mellitus)
Hypercalcaemia
Hypercalciuria
Low cortisol
Hypernatraemia (diabetes insipidus)

30.3

List six causes of hepato-splenomegaly. (30% marks)

ANSWER TEMPLATE

30.3

- Chronic liver disease with portal hypertension
- Viral infections e.g. viral hepatitis, EBV
- Myeloproliferative disease e.g. myelofibrosis
- Lymphoma
- Leukaemia
- Pernicious anaemia
- Amyloidosis
- Malaria
- Sarcoidosis
- Acromegaly
- Thyrotoxicosis
- SLE
- Metabolic storage disease
- Obesity
- Kala-Azar (visceral leishmaniasis)

Maximum Score	8.3
Percentage Passed	40.0%

EXAMINERS' COMMENTS

Hot Cases

The Hot Cases run for twenty minutes with an additional two minutes at the start of each case for the candidate to be given both a verbal and a written introduction to the case in question. This is to give candidates more opportunity to take in the relevant information and to plan a focussed approach to examination of the patient.

The following comments are a guide to the expected standard for performance in the Hot Cases:

- Candidates should demonstrate professional behaviour, treating the patient with consideration and respect.
- Candidates should address and answer the question asked of them in the introduction to the Hot Case.
- Candidates should interpret and synthesise information as opposed to just describing the clinical findings.
- Candidates need to seek information relevant to the clinical case in question.
- Candidates should be able to provide a sensible differential diagnosis and appropriate management plan. A definitive diagnosis is not always expected and in some cases may yet to be determined.
- Candidates should not rely on a template answer or key phrases but answer questions in the context of the clinical case in question.
- Candidates must be able to describe, with justification, their own practice for specific management issues.

Candidates who performed well in the Hot Cases, as in previous exams, were able to demonstrate the following:

- A professional approach showing respect and consideration for the patient.
- Competent, efficient and structured examination technique and also able to appropriately adapt the examination to suit the clinical case in question.
- Seeking of information relevant to the case.
- Appropriate interpretation and synthesis of their findings.
- Presentation of their conclusions in a concise and systematic fashion, addressing the issue in question.
- Listing of a differential diagnosis that is relevant to the clinical case in question.
- Appropriate interpretation of relevant investigations.
- Discussion of management issues in a mature fashion, displaying confident and competent decision-making.
- An appreciation of the complexities and key issues of the case.
- Overall performance at the expected level (Junior Consultant).

Candidates who did not perform at the acceptable standard did so for reasons including the following:

- Missing or misinterpreting key clinical signs on examination.
- Failure to perform a focussed examination relevant to the case in question.
- Incomplete or poor technique for examination of a system.
- Poor synthesis of findings with limited differential diagnosis, sometimes compounded by missed key clinical signs on examination.
- Poor interpretation of imaging and data.
- Failure to grasp the key issues relevant to the case in question and a lack of insight into the problems.

- Inability to construct an appropriate management plan for the case in question.
- Hesitancy and/or uncertainty in stating a management plan.
- The need for significant prompting during the discussion with knowledge gaps.
- Limited time for discussion as a consequence of taking too long to present the clinical findings or to interpret basic data.
- Inability to convey the impression that he/she could safely take charge of the unit.

It is apparent that some candidates are very nervous and this affects their exam performance. Candidates badly affected by nerves may benefit from sessions with a performance psychologist, drama coach, public speaking coach or similar.

Candidates are advised that they should not sit the Second Part Examination until they can confidently examine patients, present the relevant clinical findings, synthesise all the information and discuss management issues at the appropriate level, **i.e. demonstrate that they are capable of safe, effective, independent practice at the level of a Junior Consultant.** Candidates should practise Hot Cases from the commencement of their exam preparation. To this end, candidates are encouraged to do the following in their daily clinical practice as preparation for the Hot Cases:

- Seek the opportunity to take charge of the unit and be responsible for management decisions.
- Practise examination of individual systems.
- Treat every case to be assessed at work as a Hot Case, i.e. pose a relevant question (e.g. 'Why is this patient not progressing?' 'What is the cause of the new fever?' 'Is this patient ready for extubation?'), perform a focussed exam and then present your findings to a colleague.

Vivas

The overall pass rate for the vivas (73%) was the highest sectional pass rate for this exam, compared with 60% for the written paper and 45% for the Hot Cases. All eight vivas had a pass rate greater than 50%. Candidates who failed a viva mostly did so because of knowledge gaps, poorly structured answers and inability to give the rationale for their responses. As in the discussion for the Hot Cases, candidates should not rely solely on generic statements, key phrases and template answers, and, instead, tailor their responses to the specifics of the question and be able to justify and expand their response. Candidates are encouraged to practise viva technique and to discuss patient management, including the rationale for their decisions, with senior colleagues. As with the Hot Cases, candidates who are very nervous or have a poor technique may benefit from training with a performance coach.

SECOND PART ORAL EXAMINATION

CLINICALS “HOT CASES”

24-year-old male day 6 ICU following sudden decrease in conscious state to GCS 8 with a background of traumatic brain injury secondary to a motorcycle crash four months earlier. Findings included tracheostomy, decompressive craniotomy, EVD in situ, movement of right arm only. Candidates were asked to review him and make a plan for further management.

69-year-old male day 1 ICU with trauma following a fall from a ladder and admitted to ICU with progressive hypoxia. Background included OSA, type 2 diabetes and hypertension. Candidates were asked to perform a secondary survey.

84-year-old male, with a background of myasthenia gravis, stable for 30 years, and admitted to hospital for urosepsis. He was day 5 ICU following a MET call for hypoxia requiring intubation. Candidates were asked to assess him for suitability for extubation.

47-year-old male day 8 re-admission to ICU with hypoxia, pancreatitis, and multi-organ failure. Recent four-month admission to ICU with TB and meningo-encephalitis. Background of polio. Findings included cachexia, jaundice, and lower limb neuropathy. Candidates were asked to examine him with a view to a plan for further management.

63-year-old male with re-do coronary surgery day 9 ICU admission. Candidates were asked to examine him with a view to determine and discuss potential causes of difficulty with weaning from mechanical ventilation.

72-year-old female day 7 ICU, admitted with vomiting, shortness of breath and hypotension on a background of type II diabetes. Candidates were asked to suggest a differential diagnosis for the presentation and formulate a management plan.

53-year-old male day 2 ICU following a mitral valve repair and coronary artery grafts. Candidates were asked to assess whether the patient was suitable for discharge from the ICU.

36-year-old male day 44 ICU, still mechanically ventilated for community acquired pneumonia leading to septic shock and multi-organ failure. Candidates were asked to assess why the patient could not be weaned off the ventilator.

77-year old male day 6 ICU, following surgery for a type A aortic dissection complicated by a CVA. Candidates were asked to determine the current significant issues and formulate a management plan.

65-year old female, day 6 ICU, following a lung transplant and needing to be re-intubated for increased work of breathing. Candidates were asked to examine to determine the possible causes for this.

79-year old male, day 22 ICU. His initial presentation was for abdominal pain and distension on a background of obesity, incisional hernia and a recent pulmonary embolus. Candidates were asked to identify the major clinical problems and discuss a management plan for the next 24 hours.

81-year old male, day 4 ICU, admitted with fever, rigors and abdominal pain. He had a background of atrial fibrillation on warfarin and peripheral vascular disease for which he had recent femoro-popliteal bypass surgery. Candidates were asked to examine to identify likely causes of fever and suggest an appropriate management plan.

58-year old male, day 15 ICU with cellulitis, painful joints secondary to gouty arthritis and oliguria. Candidates were asked to examine him gently with a view to understanding his current condition and to develop a management plan.

44-year-old male day 3 ICU following a MET call for type 2 respiratory failure due to complications of a spinal cord tumour causing cervical cord compression. Background of neurofibromatosis. Findings included intubation and ventilation, upper motor neurone lesion signs in his lower limbs, distal weakness in his upper limbs and intact cranial nerves. Candidates were asked to assess him for causes of his ongoing respiratory failure.

62-year-old male day 5 ICU with respiratory failure and persisting fever secondary to community-acquired pneumonia and empyema, with a background of type 2 diabetes and colon cancer. Findings included ongoing ventilation, left pleural drains in situ and a fluctuating level of consciousness. Candidates were asked to identify the current main problems and discuss how to move him forward.

70-year-old male day 4 ICU post MVR. Background of dyspnoea and exercise tolerance of less than 20 metres. Findings included still intubated, sedated and ventilated with vasopressor support, pulmonary artery catheter still in place and pacemaker dependent. Candidates were asked to examine him to make a plan for the day.

78-year-old male day 5 ICU post STEMI. Admitted from the cath lab following PCI with 2 stents and aspiration of thrombus, with cardiogenic shock, acute pulmonary oedema and IABP in situ. Findings included still intubated and ventilated with IABP still present. Candidates were asked to examine him from a general perspective and highlight the main issues.

66-year-old female, day 2 ICU with posterior circulation stroke treated with thrombectomy and subsequent decompressive craniectomy. Findings included atrial fibrillation, bruise over the right groin, posterior fossa craniotomy, presence of an EVD and right upper limb mono paresis. Candidates were asked to examine her and outline a management plan for the next 24-48 hours.

59-year-old female day ICU admitted with cough and shortness of breath requiring ventilation. Background history includes hyperthyroidism. Findings included pyrexia and ventilation with APRV and high FiO₂. Candidates were asked to examine her to determine the cause of her respiratory failure and to make a management plan.

VIVAS

Viva 1

You are the treating consultant on call for the ICU. At 0130 hr you receive a phone call from your ICU registrar with whom you have not previously worked.

The call is about a 36-year-old female who has been in ICU for 5 days. She was admitted 5 days ago for a subarachnoid haemorrhage, World Federation of Neuro Surgeons (WFNS) grade 3 from a right middle cerebral artery (MCA) aneurysm. She underwent emergency coiling for the same.

She has been extubated for 24 hours. She has an external ventricular drain, currently set to drain at 10 cmH₂O.

Her Glasgow Coma Score (GCS) has been 10-12 until tonight when she was noted to be “not herself” for 1-2 hours. She is now drowsy and is becoming difficult to rouse.

What is your response to the clinical problem presented in this phone call?

Maximum Score	8.5
Percentage Passed	73.0%

Viva 2

A 27-year-old male (80 kg) is found after an explosion in his home garage.

On arrival in the Emergency Department he has a Glasgow Coma Scale (GCS) 8 (E2 V2 M4), SpO₂ 88% on 15 L.min⁻¹ oxygen, respiratory rate 40 min⁻¹, heart rate 123 beats/min and blood pressure 88/45 mmHg.

The diagram below demonstrates the surface area burnt. Red areas reflect partial or full-thickness burns and the blue areas are superficial burns.

Describe your assessment and management priorities specific to the burn injury.

Maximum Score	9.0
Percentage Passed	73.0%

Viva 3

A 45-year-old male is admitted to hospital with an upper gastrointestinal bleed and undergoes endoscopy and banding of oesophageal varices. His Glasgow Coma Scale (GCS) at presentation was 15.

Over the next 24 hours the patient has a progressive decrease in conscious level. You are called by the new medical consultant, who suspects the patient has hepatic encephalopathy, and wants him admitted to ICU.

How would you assess the patient to determine the cause of the altered level of consciousness?

Maximum Score	7.1
Percentage Passed	55.0%

Viva 4

A 58 year-old male, Mark, has been admitted to the ICU post semi-elective three-vessel coronary artery bypass graft, 10 days after an anterior ST-elevation myocardial infarction. The procedure was uncomplicated, however he became more hypotensive towards the end of the procedure and had an intra-aortic balloon pump (IABP) inserted to assist with separation from cardiac bypass. The surgeon has confidence with the patency of the grafts.

Mark is now 1 hr post-op in the ICU, fully ventilated and sedated, with an IABP in situ, and you have been asked to review his increasing noradrenaline requirement.

His clinical status is:

Heart Rate 110 beats/min sinus rhythm

Synchronised Intermittent Mandatory Ventilation (SIMV) 550ml x 16,

PEEP 8 cmH₂O, FiO₂ 0.5, SpO₂ 98%

Blood Pressure 95/55 mmHg, Mean Arterial Pressure (MAP) 65 mmHg

Noradrenaline 0.3 mcg/kg/min (has doubled in last 30 min)

IABP @ 1:1

Urine output 5ml for the past 1 hour
Mediastinal drains 10 ml in the past hour
Temperature 34.9°C

Describe your immediate assessment of the patient.

Maximum Score	9.3
Percentage Passed	73.0%

Viva 5

A 51-year-old female with a 20 pack-year history of smoking is now day 10 in your ICU with community acquired pneumonia.

The bedside nurse calls you and describes increasing oxygen requirements over 15 minutes, high airway pressure alarms on the ventilator and persistently low oxygen saturations.

She is mechanically ventilated via an oral endotracheal tube with a moderate volume of sputum on suctioning, on volume controlled ventilation with the following parameters:

FiO₂ 0.80
Tidal volume (V_t) 400 mls
Respiratory rate 15 per min
PEEP 10 cmH₂O
Peak airway pressure 35 cmH₂O

Her ABG result shows pH 7.25, pCO₂ 60 mmHg, pO₂ 50 mmHg.

Describe your assessment and management.

Maximum Score	7.7
Percentage Passed	70.0%

VIVA 6 – Procedure Station

This is a procedure viva. The two examiners will ask you specific questions regarding the situation below. You will be asked to demonstrate as well as explain some of your answers.

As the Intensivist at a regional hospital, you are asked to the Emergency Department to assist in the resuscitation of a 10-day-old infant that has presented in a moribund state. The child was the product of a normal pregnancy, and was delivered vaginally at 38 weeks. There were no significant problems and the child was discharged at 24 hours, having initiated breast feeding. There has been a history of diarrhea and vomiting in the family for the past 5 days.

The child is grey in colour, making weak crying noises, and has a respiratory rate of 50 breaths per minute.

How would you assess this child's circulation?

Maximum Score	9.0
Percentage Passed	73.0%

Viva 7 – Radiology Station

(The radiology station comprised five plain films and three CT scans.)

Maximum Score	9.4
Percentage Passed	73.0%

VIVA 8 – Communication Station

You are taking over the care of Tina, 40-year-old female, who was admitted 5 days ago after an intentional overdose of propranolol. On presentation to the Emergency Department 5 days ago, she had a witnessed PEA cardiac arrest, and was resuscitated with return of spontaneous circulation after a downtime of 5 minutes.

Subsequently in the ICU, she has had a stormy course requiring mechanical ventilation, dialysis, high dose insulin dextrose therapy, and high dose adrenaline infusion resulting in ischaemic fingers and toes. However, this has been improving in the past 48 hours, with a reduction in adrenaline requirement. Sedation was ceased this morning to facilitate neurological assessment.

You are about to meet with Tina's sister/brother Susan/Sam. Prior to the meeting, the bedside nurse tells you that Susan/Sam found a suicide note written by Tina describing she wanted to end her life and did not want to suffer anymore.

Susan/Sam is in the waiting room.

Maximum Score	9.5
Percentage Passed	52.0%